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ABSTRACT

The use of Videotape-Electrowriter Remote Mode (VERM) to deliver advanced level engineering graduate courses to student not on the University of Tennessee campus is described. Begun initially as an experimental project in 1969 using videotape equipment to record blackboard presentations, classes are now sent to other campuses and to industries throughout the Southeast using telephone-electrowriter connections. The University of Tennessee currently dedicates two classroom to the taping of on-campus lectures. Master of Science degrees are offered in engineering administration, chemical and metallurical engineering, civil and environmental engineering, and mechanical and aerospace engineering. A total of 135 different courses have been offered, and these have generated a total of 3,134 non-resident enrollments. (DGC)

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A REPORT ON THE VIDEOTAPE-ELECTROWRITER REMOTE MODE PROGRAM IN ENGINEERING OF THE UNIVERSITY OF TENNESSEE

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Although there is often something insular if not isolationist about the academic mind, the direction of higher education in America during the past decade has been outward and away from the "halls-of-learning" tradition. It has been known for a good while that colleges do not rest on holy ground, but only lately has appreciation been growing for the kind of "off-campus philosophy" Gayle Childs put forth to the National University Extension Association in April, 1973:

> For the learner it doesn't make any difference if he is by himself, in a small group, or in a large group. It doesn't make any difference if his exposure to learning, of whatever kind, is in the morning or the afternoon, or in the evening. It doesn't make any difference if he is in a room called a classroom, in a lodge hall, in an empty store building, or at a table in the family kitchen.
>
> It just doesn't make any difference.
>
> It is necessary, if learning is to occur, that sensory impressions be received by the learner. There must be an imput of information which is the basis for learning. But there is no consistent evidence which establishes that any form of providing imput is superior to others. In fact, the evidence is overwhelmingly to the contrary.1

Faculty and administrative approval for this kind of thinking is, to say the least, far from universal, for suspicions linger still that off-campus programs must, by definition, be of inferior quality. Nevertheless, it has often been shown that adventures in nontraditional instruction, when properly formulated, can maintain the highest standards of the sponsoring institution and thereby provide a worthy alternative to study in residence. This report will focus on one such program of the University of Tennessee: the videotape-Electrowriter remote mode (VERM) project serving the UT Knoxville College of Engineering, which is today our most convincing argument for extended learning.

Modeled on the State University Research in Graduate Education (SURGE) system of Colorado, the videotape-Electrowriter program offers engineers in many areas of the Southeast the chance to earn graduate degrees in a number of specialized fields. It is the sequel to the "remote blackboard" arrangement developed in Knoxville in the mid-1960's to put the engineering professor and his off-campus students in touch by means of telephone and Electrowriter exchanges. This early remote mode had a number of selling points:

> (1) With suitable preparation on the part of the instructor, it provides a highly efficient means of information transfer. (2) The opportunity exists for immediate feedback . . . . (3) It saves the

> expense and wear and tear on the instructor that would be entailed by regular travel to the remote class. (4) It is a relatively inexpensive means of communication. The equipment required for an Electrowriter classroom includ[es a] transmitter-receiver, and accessories such as screens, microphones, speakers, and data phone . . . . The major cost is that associated with the long distance telephone lines. Two lines are required for each class, one for the voice transmission and one for the Electrowriter signals. However, since the University has systems of leased WATS lines and the classes are taught primarily in the evening when the WATS lines are not in use, there are no appreciable incremental telephone costs chargeable to the Electrowriter classes.2

The remote blackboard setup was first used in spring, 1966, to extend a course in fluid mechanics to graduate students in Kingsport, Tennessee (a distance of about one hundred miles). And its success was such that early the following year, a decision was made to continue and expand the experiment. With the support of Hilton A. Smith, chief officer on the Knoxville campus for graduate studies, Charles H. Weaver, then Dean of Engineering, and George W. Gleaves, Director of Continuing Education, remote centers were soon established and operating at the Space Institute in Tullahoma, Tennessee, on the UT campuses in Nashville and Chattanooga, and in several private industries (e.g., Monsanto in Decatur, Alabama). This was a good beginning, but the form of extension was restricted to verbal and written communications. Therefore, when more sophisticated equipment became available, it was generally agreed that the quality of instruction for remote students could be "markedly enhanced by the use of videotapes prepared from a regular on-campus class in a classroom specially equipped with television camera, microphones, and videotape recorders."3 Videotape would permit a more complete extension of the resident product and assist in reducing the time needed for telephone-Electrowriter contact.

In Winter Quarter, 1969, the VERM project commenced with the taping and delivery to 13 students at UT Nashville of Industrial Engineering 5710 (Linear, Quadratic, and Dynamic Programming), taught by Professor J.R. Buchan. Remote blackboard and telephone were again used but this time with the assistance of videotape:

> The tapes were sent to Nashville and were played back on a set schedule. Just prior to each playback session, the instructor established telephone contact with the class and carried on a two-way discussion of the previous lesson, homework, etc., using the Victor Electrowriter to provide written communication. These . . . sessions were supplemented with several personal visits by the instructor during the quarter.4

Standard procedure called for shipping the tapes from Knoxville as quickly as possible to minimize the lag between on-campus recording and off-campus viewing and thus permit the remote students to keep pace with the students in residence. Although experimental, the first VERM presentation proved

itself, and the project expanded quickly. The very next quarter, for example, four courses (Special Industrial Engineering Topics; Advanced Engineering Economy; Polymer Processing; and Queuing Models, Inventory and Simulation) were delivered to 43 students at five sites across the state. In succeeding quarters, expansion continued in similar increments.

From the beginning, the efficiency and quality control of the videotape-Electrowriter mode have been primary concerns, and the College of Engineering has frequently surveyed remote students to keep watch on its effectiveness. A project of this size and with so many movable parts will, of course, have its problems: occasional equipment malfunctions, difficulties for some instructors in adapting to the videotape medium, the sometimes complex logistics for shipping tapes and course materials, and complications in coordinating on- and off-campus assignments and examinations. But despite these headaches--which occur less often than one might expect--most teachers and students are quite pleased with the program's workability. In fact, a great many of those surveyed have consistently evaluated the VERM mode as at least 80 per-cent as effective as live classroom presentation.

Careful attention has also been given to providing adequate library facilities for videotape-Electrowriter students. Those enrolled at remote locations on college or university campuses are able to draw upon local resources, while students at private industries usually have at their disposal rather formidable technical libraries. In addition, the UT Knoxville library system serves as a supplementary facility. Other possibilities exist as well: engineers in Decatur, for instance, can secure books through interlibrary loan and the greater Monsanto library system, and they have access to resources at the nearby Redstone Arsenal.

In serving these distant students, the University profits itself. Perhaps most importantly, the videotape-Electrowriter project and programs similar to it work against the stubborn notion that higher education must be a resident affair, for they generate a kind of outward-bound flow which gives the lie to the hallowed belief that one's physical presence "in school" is a necessary if not a sufficient circumstance for learning. In the VERM mode, the professor's product is marketed in the "real world," where the valuable collisions between theory and practice most often occur; and in turn this aids the University in justifying its existence to taxpayers who have grown increasingly more cautious in providing educational funds. Actually, the remote student himself, by his very remoteness, is a tax break. Of him, Albert J. Morris, president of Genesys Systems, has said:

> He does not take up critical classroom and parking space. He does not use up funds available for fellowships, grants, or research assistantships. His impact on the university's overhead is minimal. Rather than representing a cost to the university, the off-campus student can, in a properly designed program, represent a net income to the university which could be used to expand and upgrade the faculty.5

Six years of continual growth have brought significant change to the videotape-Electrowriter project. Soon after the initial decision to go ahead,

two classrooms were "electrified" to tape on-campus lectures and another was equipped to serve as control room. In the early going, processing was done on one-inch videotape, but the playback units for this mode were too unpredictable. This necessitated a shift to half-inch equipment, which performed well from the start and is now used exclusively. As indicated above, the most dramatic changes have occurred in enrollments and increased program variety. With the approval of the Southern Association of Colleges and Schools, the College of Engineering now offers a Master of Science degree in each of the following specialties via remote classes: engineering administration, chemical and metallurgical engineering, civil and environmental engineering, electrical engineering, industrial engineering, and mechanical and aerospace engineering.6 The results of this approval from the association, which is currently conditional pending a final review, are impressive: through Winter Quarter, 1975, 135 different courses have been offered (117 from the College of Engineering, one from Liberal Arts, five from Home Economics, two from the Graduate School of Social Work, and ten from the College of Business Administration) and have generated a total of 3134 non-resident enrollments. (See the attached table of statistics.)

At present there are remote centers on all campuses of the University, at two of Tennessee's community colleges (Jackson State and Columbia State), at Tullahoma, and in a number of industries throughout the Southeast, most of which have financed and installed their own remote teaching stations (e.g., Olin Corporation, Pisgah Forest, North Carolina; Monsanto, Guntersville and Decatur, Alabama, and Pensacola, Florida; and Cities Service Corporation, Copperhill, Tennessee).7 This expansion and the College of Engineering's compliance with the guidelines for off-campus graduate work set forth in the Southern Association's Standard Ten make it probable that the videotape-Electrowriter program, upon review, will be continued on a permanent basis.

NOTES

1 Gayle B. Childs. "Correspondence Study: Concepts and Comments" (text of an address delivered to the NUEA delegates in Omaha, Nebraska, April 13, 1973), 24

2 John W. Prados and Buford Smith, Jr. "Graduate and Continuing Education for Engineers by Videotape and Telelecture" (undated report), 4-5.

3 Fred N. Peebles. "Spotlight on the College of Engineering," The Orange Peel, Fall, 1970, 10, 13.

4 John W. Prados. "Remote Teaching Evaluation," July 22, 1969, 1.

5 Albert J. Morris. "University-Industry Television, Radio and Telephone Links," 2. (Unpublished paper)

6 Early in 1970, the University's Graduate Council took under consideration the feasibility of offering all remote videotape-Electrowriter courses for resident credit. It was decided to seek approval for this from the Southern Association following the College of Engineering's completion of a "formal description of the program" that would "deal with current standards for graduate resident instruction and would indicate how these standards would be met. Of particular concern would be issues such as: standards for approving remote receiving locations; library standards; and ways in which 'a campus atmosphere' might be approximated." From the Graduate Council Minutes for February 12, 1970.

7 Out-of-state students in the VERM program, as in any of the University's extension efforts, are subject to out-of-state fees.

STATISTICS

The following statistical table is inclusive, covering the period from Winter Quarter, 1969, through Winter Quarter, 1975. The number in parentheses following each course title indicates the number of quarters that particular course has been offered remotely.

Abbreviation Key:

Acct = Accounting
AE = Aerospace Engineering
BLaw = Business Law
ChE = Chemical Engineering
CE = Civil Engineering
Econ = Economics
EE = Electrical Engineering
EM = Engineering Mechanics
EnvrE = Environmental Engineering
Fin = Finance
IE = Industrial Engineering
IM = Industrial Management
IA = Institution Administration
Mktg = Marketing
ME = Mechanical Engineering
MetE = Metallurgical Engineering
NE = Nuclear Engineering
Nu = Nutrition
SW = Graduate School of Social Work
Soc = Sociology
Stat = Statistics
Tr = Transportation

COURSE DEPARTMENT AND NUMBER		COURSE TITLE	TOTAL REMOTE ENROLLMENT
Acct	5810	Accounting for Control(3)	62
AE	5240	Aerodynamics of Viscous Fluids(2)	7
BLaw	5100	Legal Environment of Buisness(3)	97
ChE	3330	Physiological Chemistry(1)	14
ChE	4130	Introduction to Optimization(2)	11
ChE	4910	Applied Polymer Science(2)	37
ChE	4920	Polymer Processing(7)	37
ChE	5210	Process Dynamics(2)	33
ChE	5220	Pavement Design(1)	6
ChE	5240	Control of Complex Chemical Processes(1)	9
ChE	5250	Chemical Process Industry Economics(1)	4
ChE	5310	Thermodynamics of Heterogeneous Equilibrium(3)	14
ChE	5510	Chemical Reactor Design(1)	18
ChE	5620	Differential Mass Transfer Operations(2)	21
ChE	5650	Mechanical Behavior of Solid Polymers(1)	29
ChE	5810	Mechanics of Viscous Flow(1)	10
CE	3110	Highway Design and Construction(1)	4
CE	4220	Foundations and Structures(1)	9
CE	4230	Contracts and Specifications(1)	5
CE	4510	Advanced Structural Design(1)	5
CE	5120	Statistically Indeterminate Structures(3)	16
CE	5610	Behavior of Steel Structures(1)	3
CE	5730	Prestressed Concrete(2)	13
CE	5740	Behavior of Reinforced Concrete Members(1)	4
CE	5810	Traffic Engineering: Characteristics(2)	12
CE	5820	Traffic Engineering: Operations(3)	16
CE	5830	Traffic Problems Analysis(1)	3
CE	5840	Geometric Design(1)	4
CE	5850	Function Design of City Streets and Urban Freeways(1)	15
CE	5860	Urban Transportation Planning(1)	7
Econ	5070	The Firm and Its Environment(2)	19
Econ	5080	The Firm and Its Environment(2)	14
EE	5060	Electrical Engineering Research(1)	16
EE	5070	Modern Transform Methods(5)	48
EE	5080	Modern Transform Methods(6)	39
EE	5090	Fourier Transform and Random Processes(4)	22
EE	5110	Introduction to Network Analysis(1)	10
EE	5120	Introduction to Network Synthesis(1)	6
EE	5130	Advanced Network Analysis(1)	5
EE	5410	Power Systems(2)	16
EE	5420	Power Systems(2)	15
EE	5430	Power Systems(2)	11

COURSE DEPARTMENT AND NUMBER		COURSE TITLE	TOTAL REMOTE ENROLLMENT
EE	5570	Electronic Switching Circuits(2)	21
EE	5580	Electronic Switching Circuits(1)	15
EE	5590	Electronic Switching Circuits(2)	12
EE	5610	Logic Circuits and Digital Computers(1)	15
EE	5620	Logic Circuits and Digital Computers(1)	13
EE	5630	Logic Circuits and Digital Computers(1)	9
EE	5800	Power Transmission Lines(1)	9
EM	2705	Elementary Statics and Dynamics(1)	8
EM	4910	Introduction to Ceramic Engineering(1)	1
EM	5110	Fluid Dynamics(1)	3
EM	5800	Introduction to Continuum Mechanics(1)	7
EM	5860	Introductory Finite Element Methods(1)	8
EnvrE	4500	Water Quality Management(1)	47
EnvrE	4600	Solid Waste Management(1)	36
EnvrE	4700	Air Pollution-Air Resources Management(1)	16
EnvrE	5230	Surface Water Transport Processes(1)	9
EnvrE	5232	Sediment Transportation(1)	6
EnvrE	5710	Air Pollution(1)	27
EnvrE	5720	Air Pollution(1)	9
Fin	CLU-Part 1	Non-Credit(2)	30
Fin	5510	Survey of Financial Functions in Business(5)	228
IE	Non-Credit	(2)	60
IE	3440	Quality Control(1)	9
IE	4060	Production and Inventory Systems(1)	3
IE	4150	Project Control with CPM and PERT(8)	159
IE	4170	Automatic Process Control(1)	17
IE	4230	Scheduling Systems(5)	42
IE	4520	Engineering Economy(6)	54
IE	4540	Industrial Development(1)	46
IE	4590	Simulation(3)	10
IE	4810	Human Factors in Work Design(4)	66
IE	4860	Industrial Systems Analysis(1)	2
IE	4910	Special Industrial Engineering Topics(1)	3
IE	4930	Special Industrial Engineering Topics(1)	5
IE	4950	Industrial Safety(2)	16
IE	5110	Work Design(7)	116
IE	5210	Advanced Work Measurement(1)	3
IE	5240	Facilities Planning and Design(3)	35
IE	5250	Advanced Scheduling(1)	5
IE	5300	Seminar(4)	40
IE	5340	Applied Decision Theory(2)	40
IE	5360	Statistical Methods in Industrial Engineering(2)	29
IE	5420	Reliability Engineering(5)	36

COURSE DEPARTMENT AND NUMBER		COURSE TITLE	TOTAL REMOTE ENROLLMENT
IE	5520	Advanced Engineering Economy(7)	132
IE	5600	Human Factors Engineering(3)	35
IE	5610	Human Factors Engineering(2)	17
IE	5700	Optimization Methods in Industrial Engineering(5)	159
IE	5710	Linear, Quadratic, and Dynamic Programming(7)	139
IE	5720	Queuing Models, Inventory, and Simulation(6)	103
IE	5730	Game Theory and Random Processes(1)	5
IE	5810	Theory of Industrial Automatic Control(1)	9
IE	5920	Special Topics in Industrial Engineering(1)	3
IM	5130	Managerial Planning and Control(2)	33
IA	5230	Food Systems Evaluation(1)	5
Mktg	5100	Survey of Marketing(2)	51
ME	4631	Energy Methods in Mechanical Design(1)	5
ME	4632	Application of Lagrangian Mechanics in Vibration Problems(1)	2
ME	5120	Convection Heat Transfer(1)	1
ME	5130	Radiation Heat Transfer(2)	6
ME	5210	Classical Thermodynamics(1)	8
ME	5220	Microscopic Thermodynamics(1)	6
ME	5540	Advanced Strength of Materials(1)	7
ME	5550	Advanced Strength of Materials(1)	5
ME	5560	Advanced Strength of Materials(1)	4
ME	5670	Dynamics of Machinery(1)	11
ME	5680	Dynamics of Machinery(2)	5
ME	5990	Special Topics in Mechanical Engineering(1)	4
MetE	3150	Engineering Materials(1)	7
MetE	5110	Point Defects and Dislocations(1)	3
MetE	5120	Plastic Deformation I(1)	3
MetE	5140	Diffusion and Annealing in Solids(1)	8
MetE	5150	Phase Transformations I(1)	5
MetE	5210	Welding Metallurgy(1)	10
MetE	5220	Welding Metallurgy(1)	10
MetE	5230	Welding Metallurgy(1)	8
MetE	5840	Metallurgy of Deformation and Fracture(1)	3
MetE	5920	Metallurgical Thermodynamics(1)	4
NE	5140	Two-Phase Flow and Heat Transfer(1)	8
NE	5210	Systems Dynamics(1)	4
NE	5710	Nuclear Design(1)	4
NE	5720	Nuclear Design(1)	4
NE	5730	Nuclear Design(1)	4
NE	5840	Fast Breeder Reactors(1)	7
NE	5850	Fast Breeder Reactors(1)	3

COURSE DEPARTMENT AND NUMBER		COURSE TITLE	TOTAL REMOTE ENROLLMENT
Nu	3000	Nutrition Science(1)	16
Nu	5210	Advanced Nutrition(1)	7
Nu	5410	Human Nutrition(1)	13
Nu	5470	Nutrition and Aging(2)	14
SW	5230	Human Behavior and Social Environment III(1)	20
SW	5772	Financial Management for Social Welfare Administration(1)	7
Soc	6610	Seminar in Formal Organization(1)	21
Stat	3450	Statics for Engineering(5)	34
Tr	5210	Business Logistics(4)	81

TOTALS: 135 Different Courses
3134 Total REMOTE Students
3482 Total RESIDENT Students (who participated in the "live" classes being videotaped)